CLAIMS

What is claimed is:

1. A method for examining a specimen with a high aspect ratio feature, the method comprising:

impinging a primary beam onto an area of the specimen with the high aspect ratio feature;

extracting scattered electrons that are generated due to the impingement of the primary beam onto the specimen;

applying a filter to remove the scattered electrons with characteristics outside of a selected filter range; and

detecting the scattered electrons with characteristics inside of the selected filter range to generate image data relating to the high aspect ratio feature.

2. The method of claim 1, wherein the filter comprises an energy filter, wherein the filter range comprises an energy range, and wherein applying the energy filter removes the scattered electrons with energies outside the energy range.

3. The method of claim 2, wherein the energy range comprises energies below a threshold energy, and wherein the threshold energy relates to a potential difference from a bottom of the high aspect ratio feature to a surface of the area surrounding the feature.

4. The method of claim 1, wherein the filter comprises an angular filter, wherein the filter range comprises an angular range, and wherein applying the angular filter removes the scattered electrons with angles outside the angular range.

5. The method of claim 4, wherein the angular filter comprises an aperture in a pupil plane.

6. The method of claim 1, wherein a large portion of the unfiltered scattered electrons generated from the high aspect ratio feature are generated from sidewalls of the feature.

7. The method of claim 6, wherein the filter removes a majority of the scattered electrons generated from the sidewalls of the high aspect ratio feature.

8. The method of claim 1, wherein the method further comprises moving a stage holding a series of specimens for high throughput in-line inspection of the specimens.

9. The method of claim 1, further comprising processing the image data for automated examination of the specimen.

10. The method of claim 9, wherein the processing includes comparing data from a die being inspected with reference data to identify high aspect ratio defects.

11. The method of claim 10, further comprising recording identified high aspect ratio defects in a database.

12. The method of claim 9, wherein the processing includes analysis to classify identified high aspect ratio defects.

13. The method of claim 12, wherein the analysis comprises rule-based analysis.

14. The method of claim 1, further comprising impinging an auxiliary beam to control the charging of the specimen.

15. The method of claim 14, wherein the auxiliary beam comprises a photon beam, and wherein electrons are emitted from the specimen due to photoemission.

16. The method of claim 14, wherein the auxiliary beam comprises a second electron beam.

17. The method of claim 1 further comprising varying the selected energy range to achieve depth profiling of the high aspect ratio feature.

18. An apparatus for examining a specimen including a high aspect ratio feature, the apparatus comprising:

a source and lenses for impinging a primary beam onto an area of the specimen;

an extraction mechanism for extracting scattered electrons that are generated due to the impingement of the primary beam onto the specimen;

a filter for filtering out the scattered electrons with characteristics outside of a selected filter range;

a detector for detecting the scattered electrons with characteristics inside of the selected filter range to generate image data relating to the area of the specimen; and

a computing device for processing the image data in relation to the high aspect ratio features.

19. The apparatus of claim 18, wherein the apparatus comprises an inspection tool that is capable of detecting defects relating to the high aspect ratio features in specimens being manufactured.

20. The apparatus of claim 18, wherein the apparatus comprises a review tool that is capable of defects to the high aspect ratio features in specimens being manufactured.

21. The apparatus of claim 18, wherein the apparatus comprises a critical dimension scanning electron microscope that is capable of measuring dimensions of the high aspect ratio features.

22. The apparatus of claim 18, wherein the source comprises an electron source, and wherein the primary beam comprises a primary electron beam.

23. The apparatus of claim 22, wherein the primary electron beam comprises a low-energy electron beam, and wherein the apparatus comprises a low-energy electron microscope.

24. The apparatus of claim 18, wherein the primary beam comprises a photon beam, and wherein the apparatus comprises a photo-emission electron microscope.

25. The apparatus of claim 18, wherein the filter comprises a device from a group of devices including an electrostatic grid, an omega filter, and a Wien filter.

26. The apparatus of claim 18, wherein the filter as implemented comprises an angular filter for selecting electrons emitted approximately perpendicular to the specimen's surface.

27. The apparatus of claim 26, wherein the angular filter comprises an aperture located in a pupil plane of the apparatus.

28. The apparatus of claim 18, wherein the detector is located in a pupil plane of the apparatus so as to implement the filter by said location of detector.

29. A method for energy-filtered electron beam inspection, the method comprising:

capturing first image data set including electrons with energies above a first threshold energy level;

capturing second image data set including electrons with energies above a second threshold energy level; and

generating band-pass energy filtered image data by subtracting one said image data set from the other said image data set.

30. The method of claim 29, wherein capturing the first and second image data sets are performed during alternate scanned image frames.

31. The method of claim 30, wherein the threshold energy levels are applied using a conductive energy filter mesh modulated with alternating voltages.

32. The method of claim 31, wherein transition between the alternating voltages is performed at a frame capture frequency.

33. The method of claim 29, wherein at least one of the image data sets is normalized prior to the subtracting.

34. An apparatus for energy-filtered electron beam inspection, the apparatus comprising:

a voltage generating system configured to generate a first voltage level and a second voltage level and to output in an alternating fashion the first and second voltage levels at a frame capture frequency;

an electron detector configured to detect a first image data set of electrons with energies above a first threshold energy level in response to the first voltage level and to detect a second image data set of electrons above a second threshold energy level in response to the second voltage level;

a first memory buffer region configured to store the first image data set;

a second memory buffer region configured to store the second image data set; and

a band-pass image generator configured to generate a band-pass image data set by subtraction of the second image data set from the first image data set.

35. The apparatus of claim 34, wherein the voltage generating system comprises:

a first power supply for providing the first voltage level;

a second power supply for providing the second voltage level;

a relay switch for selecting between the first voltage level and the second voltage level and for outputting said selection; and

a scan generator for providing a trigger signal to the relay switch,

wherein the trigger signal causes the relay switch to alternate said selection between the first and second voltage levels at the frame capture frequency.

36. The apparatus of claim 34, wherein the voltage generating system comprises:

a scan generator for providing a trigger signal;

a converter for converting the trigger signal to an analog control signal; and

a variable power supply to output the first voltage level when the analog control signal is at a first level and to output the second voltage level when the analog control signal is at a second level,

wherein the trigger signal causes the variable power supply to alternate the output between the first and second voltage levels at the frame capture frequency.

37. The apparatus of claim 34, wherein the electron detector comprises:

an energy filter mesh to which the first and second voltage levels are applied; and

a detector area to detect the electrons with energies above the first threshold energy level when the first voltage level is applied to the energy filter mesh and to detect the electrons with energies above the second threshold energy level when the second voltage level is applied to the energy filter mesh.